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RESEARCH ARTICLE

Challenges of assessment and mapping of ecosystem services in Bulgarian (Rhodope) and Russian (Altai) mountain protected areas in the context of post-socialist transformations and new conservation paradigms

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Abstract

The overarching goal of this survey was to identify the challenges of ecosystem services assessment and mapping in Russian and Bulgarian mountain protected areas in the context of post-socialist transformations, new conservation paradigms and climate change. The Altai Mountains in Russia and the Rhodope Mountains in Bulgaria were selected as key mountain territories for comparison due to their similar characteristics: agriculture, forest exploitation, tourism activities, etc. Both in Bulgaria and in Russia, perceptions of the protected areas functioning have been changing, facilitated by global shifts. Thus, the concept of ecosystem services has now been actively introduced in nature and biodiversity conservation policies. Based on WDPA data the emergence of different types of protected areas in Russia and Bulgaria was determined. Key problems of assessment and mapping of ecosystem services in Russian and Bulgarian mountain protected areas were recognised, mainly related to the shortage and quality of baseline data. At the same time, there were also some specifics for the two countries due to their size and national legislation. Like many other mountainous regions in the world, the Rhodopes in Bulgaria and the Altai

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Mountains in Russia are flagships in the improvement of nature conservation strategies. These regions often participate in a variety of international conservation programmes and are constantly expanding the range of protected areas. It is generally accepted that the Altai Mountains and the Rhodopes are not only centres of biodiversity richness in their countries, but also hotspots of a variety of ecosystem services.

Keywords
ecosystem services, mountain protected areas, Bulgaria, Russia, Rhodopes, Altai

Introduction

Mountains have been recognised as flagship lands of nature conservation around the world (Catalan et al., 2017), because of their biodiversity richness, water resources (water towers), soils, cultural and spiritual values, which are best maintained in protected areas (PAs) (Körner, Ohsawa, 2006; Hamilton, 2006; Viviroli, Weingartner, 2008; Grêt-Regamey et al., 2012). The diverse vegetation is important for soil erosion prevention on steep slopes, thereby contributing to the protection of landscapes and populations against natural hazards and the impact of extreme events (Körner et al., 2017). Accordingly, mountain areas are recognised as ecosystems supplying a vast variety of provisioning, regulating and cultural ecosystem services (ES), globally and at the European level (Maes et al., 2011; Grêt-Regamey et al., 2012) and represent areas of prime conservation value (Messerl, Ives 1997; Hamilton 2002; Körner, Ohsawa 2006).

Russia and Bulgaria have significant experience in the establishment and management of mountain protected areas. The first Russian reserve "Barguzin Zapovednik" was established in 1916 in the mountain near Lake Baikal. The first reserve in Bulgaria "Silkosia" (declared in 1931) and the first nature park "Vitosha" (established in 1934) are both situated on mountain territories. There are many changes in Russian and Bulgarian management of protected areas over the past few decades. The collapse of socialism, as well as a new conservation strategy, triggered these changes.

Russia and Eastern Europe have undergone drastic changes after socialism. The shift from a socialistic-planning system to a market-oriented economy has resulted in fundamental changes to the political and social institutions, as well as in economic conditions (Bicik et al., 2001). These changes affected land management and land-use decisions. Land reforms were carried out, including privatisation and individualisation of land use. Economic and political conditions changed again considerably for some Eastern European countries with their accession to the European Union.

The general trends in land use/land cover change have been described by various studies focusing on the conditions in agriculture, forestry and urban development. Several studies have mapped the rates and spatial patterns of post-socialist cropland abandonment in Eastern Europe (Kozak et al., 2007; Kuemmerle et al., 2008; Alcantara et al., 2013; Prishchepov et al., 2013; Nguyen et al., 2018). An increase in forest extent, but especially the change in forest structure, has been documented for the post-1989 era in some countries (Kozak, 2003; Václavík, Rogan, 2009; Taff et al., 2009; Baumann et al., 2012). There are a number of studies comparing rates of land-use

change among Eastern Europe countries, thus contributing to understanding how differences in institutional environments across similar ecological zones can affect land use (Alix-Garcia et al., 2016).

On the other hand, the Millennium Ecosystem Assessment (2005) mainstreamed the new paradigm for protected areas – conservation for human well-being. The new paradigm implies a broader and more adaptive social-ecological approach for protected areas and their surrounding landscapes that includes both the intrinsic value (i.e., biodiversity conservation) and the instrumental value of nature (Kareiva, Marvier, 2012; Palomo et al., 2014). This paradigm is a consequence of the emergence of the ecosystem services approach – one of the most crucial changes in conservation science in the last years (Armsworth et al., 2007).

In 2008, the International Union for Conservation of Nature's (IUCN) definition of protected areas included the term "ecosystem services". A Protected Area is "a clearly defined geographical space, recognised, dedicated and managed through legal or other effective means in order to achieve the long-term conservation of nature with associated ecosystem services and cultural values" (Dudley, 2008). This event could be defined as the largest revision of the conservation conceptual framework in the century.

At the same time, integrating ecosystem services in protected areas management is challenging because traditionally such areas have not been designed for the supply of provisioning, regulating and cultural services (Laurence et al., 2012; Martín-Lopez, García-Llorente, Palomo, Montes, 2012; Zorrilla-Miras et al., 2014).

Initially, the declaration of protected areas was rooted in the concept of stable nature in which the only perturbing element was human activity. Nowadays, direct human pressure around the reserve areas is still a major problem to deal with for conservation in many places. In contrast with other exploited ecosystems, high mountain areas maintain a high degree of wilderness, to some extent related to the imposed winter cessation of activities and the noticeable proportion of land scarcely exploitable (rocky and scree areas, alpine heath-land, fell-fields, etc.) (Catalan et al., 2017).

Today, climate change is indeed occurring. Mountains are particularly exposed to some of the atmospheric global change effects (Steffen et al., 2015) due to significant environmental gradients. Besides, mountain ecosystems tend to exhibit steep environmental gradients over relatively short distances (Beniston, 2003; Lloret, 2017).

The tight integration of protected areas into social-ecological systems may harm mountain regions. Growing evidence is emerging on the profound shifts caused by human activities at several levels of the high mountain wilderness, such as depletion or vanishing of large mammal's populations, alien fish introduction, uneven grazing by domestic herbivores, overuse of running waters or forest exploitation (Catalan et al., 2017). Therefore, conservation faces global change hazards exposed to regional socio-economic changes, which ultimately will also be conditioned by climate change.

Thus, our overarching goal was to characterise the challenges of ecosystem services assessment and mapping in Russian and Bulgarian mountain protected areas in the context of post-socialist transformations, new conservation paradigms and climate change.

The Altai Mountains in Russia and the Rhodope Mountains in Bulgaria were selected as key mountain territories for comparison due to their similar specific characteristics: agriculture, forest exploitation, tourism.

Our specific research tasks were to analyse the directions of transformation of the protected area systems in Russia and Bulgaria at the post-socialist time; the prospects for the functioning of mountain protected areas under the new conservation paradigm; the main challenges encountered in the assessment and mapping of ecosystem services in mountain protected areas.

Bulgarian and Russian mountain protected areas: conservation versus extraction

The first protected areas in Russia and Bulgaria, as well as the basic principles of the conservation system, were formed before the socialistic transformations of states and societies. However, the major development of protected areas was occurring during the socialistic regimes (Figure 1). On the one hand, the socialist system occasionally made it possible to achieve significant progress in nature conservation through political decisions that did not focus on economic aspects. On the other hand, the dual role of the government as an economic agent and a conservationist frequently led to a conflict of interests and attacks on the conservation system (McLaughlin, 1990).

The regulation of the protection of natural resources in Bulgaria began in the early twentieth century with the adoption of the laws on forests and hunting. However, the purposeful territorial protection of flora and fauna started after 1928 with the establishment of the Union for the Protection of Native Nature. The first officially declared protected area in Bulgaria is the Strandzha reserve "Silkosia", established in 1931 to protect evergreen shrub formations in the catchment area of the Veleka River. Several years after, the reserves "Parangalitsa" (1933) and "Bayovi Dupki" (1935) were declared. The first National Park "Vitosha" was established in 1934, based on the Forest Act, which allowed the existence of strictly protected forests. Thus, nature in Bulgaria began to be seen as a particular object of legal protection.

After the end of the Second World War, several new reserves were declared, some of them with a large area – "Srebarna" and "Milka (1948), "Tsarichina" and "Tisata" (1949), "Kamchiyski Longoz", "Dupkata", "Gorna Topchia" and "Alibotush" (1951), "Djendema" (1953), "Uzunbudjak" (1956), etc. In 1956, the Commission for Nature Protection was established at the Bulgarian Academy of Sciences – the first scientific nature protection institution in Bulgaria.

In the early 1970s, the interest in wildlife, protected areas and endangered species increased throughout the world and in Bulgaria. In 1976, with the establishment of the Committee for Environmental Protection and the growth of the Commission for Nature Protection into a Scientific Coordination Centre for Environmental Protection at the Bulgarian Academy of Sciences, began a new stage of nature protection activity in Bulgaria. During this period, the country actively participated in most international conservation initiatives and joined important international conventions

and programs for the protection of natural areas: the Convention on the Protection of the World Cultural and Natural Heritage (1975) and the Ramsar Convention on Wetlands of International Importance (1976). The intergovernmental program "Man and the Biosphere" at UNESCO started, the UN list of national parks and other protected areas has been expanded, in which Bulgarian protected sites have been recorded from the very beginning. As a result, two wetlands ("Arkutino" and "Srebarna") have been declared as sites of international importance and 17 sites – as biosphere reserves.

To the moment of socialism collapse, protected areas in Bulgaria reached 2% of the total area of the country. Therefore, Bulgaria already has a network of protected areas, which ranks the country after Finland and Norway and becomes the country with the largest area of reserves under a strict regime in Europe. Many protected areas had no effective management plans, while different government bodies, most often local forestry authorities and municipalities, were responsible for their management (Mihova, 1998).

Additional and more significant development in terms of environmental conservation began to take place in the 1990s with the establishment of new parks and the passage of post-socialist environmental legislation, such as the Environmental Protection Act (1991), Clean Air Act (1996), Law on Forests (1997), Law on Protected Areas (1998), Waters Act (1999) and the Public Access to Information Act (1999). In this period, the emphasis of government conservation efforts in Bulgaria began to shift away from relatively small and sometimes isolated nature reserves towards national parks covering larger geographic areas (Staddon, Cellarius, 2002).

The large protected areas in Bulgaria were established in the period 1991-1995, when the Committee for Environmental Protection was transformed into the Ministry of Environment and Waters. The interest of Western Europe and the USA in Bulgarian nature was growing significantly and in 1993, with the help of the American Agency for International Development, a strategic scheme in the field of nature protection was prepared, which coincided with the preparation of the Plan for priority activities for wetland protection. Thus, 491 219 ha or about 4.4% of the Bulgarian territory was accorded to some form of protected status by 1997, about a threefold increase over a decade (MOEW, 2000b).

The first post-socialist decade was characterised with the implementation of a more systematic approach to nature conservation in Bulgaria. In the early 1990s, Bulgaria formulated a strategy for the conservation of biological diversity with assistance from the US Agency for International Development (USAID) and the Biodiversity Support Program – a consortium of three US-based environmental organisations (Meine, 1994). The strategy was followed by the approval of a National Biodiversity Conservation Plan in 1999 (MOEW, 2000a).

In 1994, within the Ministry of the Environment, a National Nature Protection Service (NNPS) was created with primary responsibility being the conservation of protected areas and biodiversity. Further developments were the results of Bulgaria's European Union (EU) accession strategy, particularly for ensuring the harmonisation

of Bulgarian laws on protected areas, surface and coastal water quality and environmental monitoring and control with EU standards (Government of Bulgaria, 1998).

In 1998, the National Assembly voted to adopt the Protected Areas Act (PAA) – the first closely specialised nature protection law. It defines the relationship between the institutions responsible for protected areas and ensures more effective nature conservation and protection of local interests. The law also regulates the establishment of directorates to the three national parks ("Central Balkan", "Rila" and "Pirin") as their administrative bodies: independent legal entities supported by the budget and directly subordinated to the Ministry of Environment and Water. With this law the systematisation of protected areas, setting out the categories of protected areas in the country and their management was accomplished (State Gazette No. 133, 11 November 1998).

According to the Protected Areas Act (1998), the following categories of protection are defined: strict nature reserves; national parks; natural monuments; managed nature reserves; natural parks and protected sites, all subject to different management regimes and restrictions.

Of particular concern for some environmentalists was a distinction made in the legislation between "national" parks, which are protected areas owned exclusively by the government, and "nature" parks, which are those with private or mixed ownership. Under the new legislation, only three of the country's 12 parks, "Rila", "Pirin" and "Central Balkan", are accorded the status of national parks, in part due to this distinction. They are also the three sites in the country that meet the IUCN's criteria (1997) for category 2 protected areas (Staddon, Cellarius, 2002).

The ecological network of protected areas NATURA 2000 represents an instrument of the European Community aimed at the conservation of the habitats and animal species of importance for the Community and ensures free geographical dissemination of species, genetic interchange and migration. Through NATURA 2000, the European Union participates in the establishment of EMERALD network, in conformity with the Bern Convention, which encompasses the overall territory of Europe and some countries in Northern Africa.

It is important to emphasis also that at the initial stage of the selection of NATURA 2000 special protection areas within the territory of Bulgaria, very negative public reactions were raised on behalf of economic organisations including tourism businesses. The reasons for the escalations have resulted from the fact that in the scale of NATURA 2000 have been included territories which are parts of "Pirin", "Rila" and "Central Balkan" National Parks, "Pomorie" lake, "Ropotamo" complex and many other areas, which have been subject to different investment interests (Georgiev, 2010).

Study areas in Bulgaria

The Rhodope Mountains are located at one of the Europe's ecological crossroads, between Europe, Asia and the Mediterranean. The Rhodope is an ancient, European cultural landscape where productive uses of forestry and agriculture predominate, while

protected areas are small and scattered. The application of landscape-scale conservation practices and perspective to the productive landscape as whole and protected areas within it constitutes the strategic approach to securing the sustainable long-term conservation of biodiversity in these mountain territories.

Recognising the biological, cultural and scenic values of the area, the GoB has established four UNESCO biosphere reserves, five strict nature reserves (IUCN-I), ten managed reserves (IUCN-IV), 81 nature monuments (IUCN-III) and 36 protected sites (IUCN-VI). Despite such commitment, most of these protected areas are too small to conserve viable populations of flora and fauna. The existing isolated protected areas in the Rhodopes are likely to be inadequate on their own in ensuring the long-term conservation of flora and fauna because they do not fully represent all components of biodiversity in the Rhodopes and individual protected areas are inadequate to meet the ecological requirements of a number of species with low and patchy densities.

The exceptional variety of flora and fauna is the main feature of the Western Rhodope region, resulting in the designation of several protected areas, the most important of which are listed below:

The "Red Wall" Biosphere Reserve (3029.0 ha) is located in the Chernatishko-Prespa region and is a typical botanical reserve. It was declared in 1962 in order to protect the large number of plant species that grow in this area and has been expanded several times. In 1977 it was included in the list of biosphere reserves within the UNESCO program "Man and the Biosphere".

The "Kupena" Biosphere Reserve (1761.1 ha) is located on the northern slopes of the Rhodopes, northern parts of Batashka Mountain, near the town of Peshtera. It was announced in 1961 and has been modified several times and received its status as a biosphere reserve in 1977. The reserve area is a vast forest, located between 550 and 1400 m a.s.l. The most widespread are the natural European beech plantations, followed by Scots pine forests.

The "Mantaritsa" Biosphere Reserve (1069.2 ha), declared in 1968 and modified in 1992, is located in the area of the Rakitovo State Forestry, north of Syutkya Peak. It covers the localities of Mantaritsa, Petlite, Kainatsite, located around 8 km south of Rakitovo and has an altitude of 1200-1900 m a.s.l. It has been declared a reserve in order to preserve the virgin Norway spruce – silver fir – European beech forests and the typical fauna of the region.

The "Dupkata" Biosphere Reserve was declared with a decree of the Council of Ministers №14827 of June 29, 1951 with an area of 65.2 ha. After subsequent orders and changes, its area has expanded and is currently 1210.8 ha. It is located in the Western Rhodopes, in the southern parts of Batashka Mountain. The reserve covers areas with an altitude between 600 and 1300 m a.s.l. The protected area has a high conservation value, as it preserves natural forests of Norway spruce (*Picea abies* Karst.), Scots pine (*Pinus sylvestris* L.), silver fir (*Abies alba* Mill.) and European beech (*Fagus sylvatica* L.) on the southern border of their distribution in Europe.

The "Beglika" Reserve is located just northwest of the flat watershed known as Beglika. It is located 14 km southwest of the town of Batak and 5 km southeast of Golyama Syutkya Peak. It was declared in 1960 and modified in 1992. It covers 1463.1 ha of coniferous forests in the forest belt from 1600 to 1900 m a.s.l. The general assessment is that the native forest vegetation in the protected area is well preserved. The formation of Norway spruce forests predominates, which in the past covered the entire reserve and is one of the southernmost communities of spruce in its area.

The "Soskovcheto" Reserve covers an area of 177.76 ha in the land of the town of Smolyan. It was established in 1968 in order to preserve a centuries-old spruce forest, a remarkable natural landscape, rock formations, waterfalls and habitats of rare plants.

The "Kazanite" Reserve is located on the land of the village of Mugla, on the left bank of the Muglenska River, 20 km from Devin and covers 154.8 ha. It is located on extremely steep terrain and an altitude from 950 to 1500 m a.s.l. It was established in 1968 in order to preserve mixed forests of silver fir, Austrian pine, European beech and Norway spruce aged 80 – 100 years and their characteristic flora and fauna.

The "Kastrakli" Reserve (124 ha), declared in 1968 and modified in 1974, covers a part of the Malka Reka and Kobilino Branishte Valleys. It is located 3.5 km east of the village of Borino, Smolyan region, at an altitude of 1000-1200 m a.s.l. It is designed to preserve some of the best-preserved forests of Austrian pine in Bulgaria, untouched by human activity.

At its 29th session, held from 12 to 15 June 2017, the Intergovernmental Coordinating Council for the UNESCO Man and the Biosphere Program (MAB – ICC) approved the declaration of the 4th Bulgarian Biosphere Reserves, including the "Red Wall", as the nomination of the sites in 2016 was supported by the respective municipalities and responsible state institutions. The Intergovernmental Coordination Council decided to withdraw (exclude) from the world network of biosphere reserves of the "old" type – "Dupkata" and "Kupena", due to the disagreement of the respective municipalities on their territory to declare such sites. At the same session, the official deletion of the "Mantaritsa" Biosphere Reserve was postponed, for which the interested municipalities had expressed a desire to be combined with the modern requirements of the Program.

Several Natura 2000 sites were also declared in the Rhodopes:

BG0001030 "Rhodopes – Western", BG0001031 "Rhodopes – Medium", BG0001032 "Rhodopes – Eastern" and BG0000372 "Tsigansko gradishte" – protected areas under the Habitats Directive and BG0002063 "Western Rhodopes", BG0002073 "Dobrostan", BG0002105 "Persenk" and BG0002113 "Trigrad-Mursalitsa"- under the Birds Directive.

Only few protected areas in the Rhodope Mountains have management plans or data from ongoing field research. In accordance, there is very little baseline information on which to hinge a conservation program and/or a monitoring program. This fact holds especially true in the Western Rhodope. In the Eastern Rhodopes the situation is slightly better because of the work undertaken by the Bulgarian Swiss Biodiversity Conservation Programme (BSBCP), which is strengthening the management of

the three protected areas by training of staff, strengthening RIEW offices, developing and implementing management plans and supporting regional dialogue.

As a result, the National Biological Diversity Conservation Strategy (NBDCS) listed the Rhodopes as a high priority for a landscape approach to biodiversity conservation. In response, nine new protected areas in the Eastern Rhodopes are now under consideration, and more are expected to follow as the GoB works in accordance with the EU's CORINE and EMERALD network initiatives.

Under the Soviet regime, most Russian protected areas were created based on a strict protection paradigm – the so-called "Zapovednik" concept (Kozhevnikov, 1908). Zapovedniks (i.e., strictly protected, scientific state nature reserves, IUCN category Ia) were established solely for conservation and scientific monitoring. In 1951, the area of the nature reserves reached 126 000 km^2 (Ostergren, Shvarts 1998).

Protected areas in the Soviet Union have been significantly reduced (twice) due to expansion of economic use. According to The Great Stalin Plan for the Transformation of Nature, 88 nature reserves were closed in 1951 and their area decreased to 13 840 km^2 (Brain, 2010). Despite a small restoration, in 1961 Khrushchev organised a second attack on the conservation system. After the reorganisation, only 42 674 km^2 was under protection (Ostergren, Shvarts 1998). However, the reorganisation did not affect the basic idea of nature reserves as models of unspoiled nature with a strict protection regime.

Novel functions of the USSR conservation system appeared in 1983 with the establishment of the first national parks (IUCN category II). These were areas of special ecological, historical and aesthetic value which were intended to conduct environmental, recreational, educational, scientific and cultural activities. By 1994, Russia had 28 National Parks covering 64 000 km^2 (Wells, Williams, 1998).

After the collapse of the Soviet Union, protected areas were actively being created despite the lack of funding (Figure 1). In 1995, President Yeltsin signed a new federal Law on Specially Protected Natural Areas, which legalised the functions of all major types of protected areas (Ostergren, 2001). The Act has had a considerable impact on all environmental and other legislation after 1995. The law also maintained strict conservation and scientific monitoring functions for nature reserves. In the same period, many protected areas were established (or reorganised) in Russia under the auspices of international conventions (Man and the Biosphere Programme (MAB), World Heritage Programme, Ramsar Convention, etc.).

After 2000, the development of the conservation system slowed down significantly. Protected areas were handed over to the Ministry of Natural Resources and Environment, which deprived them of their independent status. The creation of new protected areas was practically suspended. Besides, the functions of protected areas began to expand steadily towards higher economic activity.

In 2011 the Concept for the Development of Specially Protected Natural Areas of Federal Importance till 2020 was approved (Government Decision, 2012). The concept provides for the creation of 11 strict nature reserves (zapovednik), 20 national parks and three federal nature reserves (zakaznik), as well as for expanding the ter-

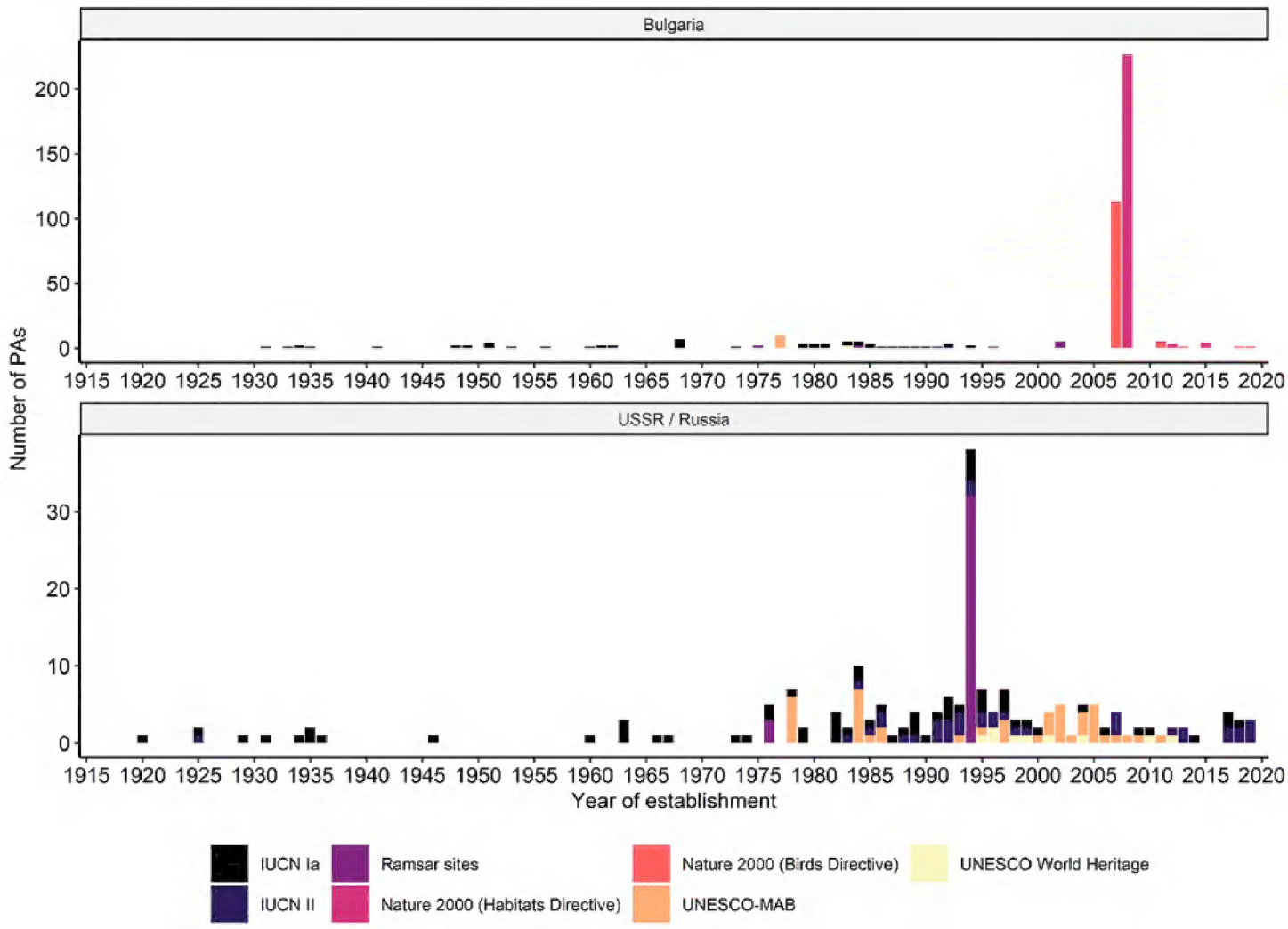

Figure 1. Emergence of different types of protected areas in Russia and Bulgaria (based on WDPA data)

ritories of the existing 11 strict nature reserves and one national park. One of the expected results is increasing the share of Russia's territory included in the specially protected natural areas of all levels to 13.5% of the entire territory of the country.

On the other hand, the Concept considers the development of cognitive tourism as one of the key directions for the development of state nature reserves and national parks in Russia. Thus, the authorities legalised the construction of tourist and sports facilities on the protected areas, including strict nature reserves (Fiorino, Ostergren, 2012; Müller, 2014). Moreover, strengthening the role of the state in the economy created new cases of pressure on protected areas and contributed to ineffective conservation measures and growing use of natural resources (Degteva et al., 2015; Shchur et al., 2017; Newell, Henry, 2017; WWF, 2017).

Study areas in Russia

Establishment of nature reserves (IUCN Ia) in the Russian Altai Mountains lasted for half a century and was associated with many challenges. "Altaisky" Reserve was established in 1932 and for a long time remained the only federal protected area. The Katunsky and Tigireksky Reserves were established only after the collapse of the Soviet Union in 1991 and 1999, respectively as the idea of establishing a protected

area on the Katunsky Ridge was first expressed by Veniamin Semenov-Tyan-Shansky back in 1917 (RGO, 2012). The "Altaisky" Reserve was closed twice by the authorities (in 1951 and 1961) due to attacks on the conservation system (Shtilmark, 2003). It resumed operating in 1967. The approved territory of the "Tigireksky" Reserve was much smaller than the one that had been initially justified by scientists, making it one of the smallest reserves in Russia. Issues, like the expansion of the "Tigireksky" Reserve, have indicated that developing a network of protected areas is still ongoing.

After the Soviet Union collapsed, novel types of protected areas with a broader range of functions started appearing in the Altai region. Moreover, the establishment of protected areas took into account the economic activities of the local communities and the interests of other stakeholders. Therefore six regional nature parks (IUCN V) were created. They mainly appeared at the most attractive sites, since the tourism development was chosen as one of the economic priorities in the Altai Krai and the Altai Republic (State Programme, 2014; Strategy of social and economic development, 2018; State Programme, 2020). The Russian Federal Government approved Sailugemsky National Park (IUCN II), which was the first in the Russian Altai (order № 241-r 27.02.2010). Initially, the park was to have the status of a nature reserve. However, the indigenous people (telengitis) feared that the Reserve would restrict their traditional economic activities, primarily grazing. The Reserve's status was modified, considering the opinions of local communities (Baylagasov, Piyantinov, 2015). On the other hand, works for creating another national park in the Russian Altai, "Gornaya Kolyvan", have been ongoing for over ten years. All stakeholders have not yet approved the boundaries of the national park. Thus, the process of adjusting new protected areas, on the one hand, allows to expand their functions significantly and to involve many stakeholders in the discussion, and on the other hand, significantly increases the time of their creation.

Another challenge is the ambiguity between regional and federal law on protected areas. During the Soviet period, the majority of protected areas in the Altai region, as well as in the whole country, were "zakazniks" (wildlife sanctuaries, IUCN IV) which had a regional status. Most sanctuaries were established in 1960-1980. They were aimed to restore the number of hunting species. Apart from hunting, many activities were legal in sanctuaries. After the collapse of the USSR, most of the sanctuaries set objectives to preserve ecosystems as a whole and nowadays, they are poorly protected. Low is the protection in particularly for forest sanctuaries. Forest lands in Russia are federal property. Therefore, forest users followed federal law and often neglected the protection regime of regional protected areas.

Protected areas are gradually expanding their tourism functions. This tendency is also relevant to nature reserves, which have been formed like areas strictly free from any economic activities except for scientific. Despite this direction, "Altaisky" Reserve has provided tourism services since its establishment, particularly near the Teletskoye Lake. The tourist potential of the area near the reserve was described back in 1937 (Dmitriev et al., 1937). The "Katunsky" and "Tigireksky" Reserves are also actively developing their tourism programmes.

In recent decades, the Altai protected areas have become a party in many international conventions and agreements, which have significantly expanded their scientific and educational functions. The Golden Mountains of the Altai natural property was inscribed on the UNESCO World Heritage List in 1998. The three parts of the property – "Altaisky" Reserve and "Lake Teletskoye", "Katunsky" Reserve and "Belukha" Nature Park, Quiet Zone Ukok Nature Park fully and integrally represented the most important and unique features of the Altai Mountains (World Heritage Committee, 1998). After the preparation of a nomination and management plan in 2013-2015, UNESCO officially approved the establishment of Asia's first transboundary biosphere reserve "Big Altai" in 2017. The "Katunsky" and "Tigireksky" Reserves were included in the "GLORIA" programme (Global Observation Research Initiative Alpine environments), aimed at the analysis of climate change impacts on biodiversity of mountain ecosystems (Maslova et al., 2015). The "Katunsky" Reserve (in 2000) and the "Altaisky" Reserve (in 2009) were granted the status of biosphere reserves and, according to that status, there have been established the areas of cooperation. These areas include the settlements bordering the protected area. Administrations of the reserves have been implementing special programmes aimed to increase opportunities for residents living near protected areas to have additional sources of income without harming nature (Yashina, 2018). In recent years, the attitude of indigenous people to protected areas in the Russian Altai has improved significantly.

However, the development of the network of protected areas in the Altai region still faces challenges in interaction with society, economic actors and various illegal activities. For example, the planned expansion of the "Tigireksky" Reserve has encountered resistance from the hunting and mining communities. Also, part of the local community is an opponent. These people believe that the expansion of the reserve will interfere with their rights to use natural resources. Over the past decades, there have been numerous proposals to build a pipeline from Russia to China through the Ukok Plateau (part of the UNESCO World Heritage). The Altai natural gas pipeline project contradicts Russia's obligations within the UNESCO's framework for the protection of world cultural and natural heritage sites (Nikolenko, Smelansky, 2011). Illegal extraction of biological resources is one of the problems that have not yet been resolved in the Altai region. Illegal hunting is not uncommon within nature reserves, including species listed in the red book, such as the Altai argali (*Ovis ammon ammon*). Cases of illegal harvesting of medicinal plants are even more frequent, e.g. *Rhodíola rósea*, *Rhodiola quadrifida*. Given these problems, the administrations of the protected areas primarily focus on cultural and educational work.

Key problems of assessment and mapping of ecosystem services in Russian and Bulgarian mountain protected areas

The ecosystem services approach is now being incorporated in protected areas and biodiversity conservation policies globally (Castro et al., 2015). Maintaining biodiversity, while contributing to human well-being, is a key thesis of the new paradigm

for protected areas. Mapping of ecosystems and their services is an important activity that can effectively contribute to understanding how ecosystems support human well-being and, furthermore, promote the sustainable use of natural resources (Burkhard, Maes 2017). In this regard, an important task is to improve the methods for assessing ecosystem services (ES), provided by protected areas (PAs). This issue, in turn, implies an analysis of the problems that arise in this assessment. Separately, it is necessary to pay attention to the problems of mapping ES provided by PAs.

The first methodological difficulty is caused by the multi-functionality of ecosystems and the number of classifications and concepts reflecting different viewpoints that have been developing over time. The variety of definitions and classifications for ecosystem services often confuse stakeholders and policy-makers (Wallace, 2008). Different classifications are based on different disciplines, different purposes of ecosystem management (e.g. de Groot et al. 2002; MEA 2005; Costanza 2008; Fischer et al. 2009) but the most accepted and widely applied classification is from the Millennium Ecosystem Assessment (MEA, 2005). However, Fisher et al. (2008) note that using this classification there is a risk for double-counting errors in cases of valuation of ecological processes, supporting multiple ecosystem services, such as weathering, soil formation, nutrient cycling, etc. Many authors consider that a common definition and classification framework for ecosystem services remains a major challenge taking into account that studies on ecosystem services are often too singular (Haines-Young, Potschin 2010, 2018; Burkhard et al., 2012), but some of them support the thesis that the definition of a common classification framework is neither feasible nor necessary (Costanza, 2008). However, the Common International Classification of Ecosystem Services (CICES) was developed in order to support work on the so-called "environmental accounting" undertaken by the European Environment Agency (EEA) and is important, as there is a need to develop standardised methods for evaluating and comparing ecosystems and ecosystem services, dividing ES into four main categories which are generally accepted today (Haines-Young, Potschin, 2018).

The analysis and assessment of ecosystem services can be highly controversial depending on different methodologies, which require further development. There are many methodological proposals (Kienast et al., 2009; Fisher et al., 2009; Haines-Young et al., 2012) which variations are being explained mainly with: differences in interpretations of ecosystem services (actual and potential), in the understanding of benefits, that they provide, characteristics of derived output database, resolution of conducted analysis and assessments, etc.

In Bulgaria in recent years, several local pilot projects considering ecosystem services were selected and performed under several funding programmes in different regions of the country. The initial mapping and assessment of ecosystems on a national scale, were performed in 2013 in the framework of the development of the national Prioritized Action Framework (PAF) (MEW, 2013), highlighting the difficulties in scaling from local to national assessment, and including the entire range of ecosystem services. The report outlining the work under PAF identified a need for validation of the resulting map due to missing timelines for many data types, as well as inconsist-

encies between databases of different institutions, non-geolocated data and a number of other data-related obstacles, preventing mapping as a mainly cameral exercise. Afterwards, the assessment and mapping work was funded under the OP Environment 2013-2020 for mapping inside NATURA 2000 (EEA, FM), identifying differences in timing and intervals of the availability of different funding sources.

The mapping and assessment were performed in parallel within several projects, each of which mapped and assessed one or two of the nine ecosystem types in Bulgaria outside NATURA 2000 at EUNIS 3 level; these mapping and assessment were finalised in 2017. These activities have led to significant progress in the country – according to the MAES barometer from level 10 in 2015 to level 20 (max 26) in 2017 (Nedkov et al., 2018).

In Russia, national ES evaluation was carried out for the first time within the project TEEB-Russia (Grunewald et al., 2014). The result of the first phase of the project (TEEB-Russia 1, 2013–2015) was the first volume of the Prototype National Report on Ecosystem Services of Russia (Bukvareva, Zamolodchikov, 2016). After the publication of this work in Russia, regional studies on the assessment of ES began (Schmalz et. al., 2016; Rosenberg, 2016), including in protected areas (Zavadskaya et al., 2017). Even though the number of such works has been steadily growing in recent years, they are still relatively rare.

Like other EU member states in the process of assessment, mapping, and valuation of ecosystems and ecosystem services, Bulgaria faces a number of gaps and challenges. As is pointed in the Methodological Framework for assessment and mapping of ecosystem condition and ecosystem services in Bulgaria, among the main constrains in the assessment and mapping process are the gaps in the data sets for selected indicators and the lack of representative time series data on main indicators for the condition (state) of the different ecosystems types. Other factors, contributing to data being not immediately available for ecosystem assessment, include interrupted time series, proprietary or incompatible data formats, non-digitalised legacy information from paper registries, etc. (Bratanova et al., 2017). To overcome the immediate limitations caused by lacking or incomplete data, the Methodological Framework (including the methodologies in Part B and the Monitoring guide – Part C) has instead adopted the approach of selecting mandatory and complementary parameters and indicators.

In Russia, a nationwide regularly updated system of data collection is also mostly lacking. One of the results of the first national assessment can be considered the identification of the so-called "white spots" in terms of the availability of statistical data on ES in the Russian Federation subjects. The authors draw attention to the fact that conducting a national ES assessment in Russia is primarily tricky due to the lack of reliable statistical data (Grunewald, 2014). Overall, supplied and consumed volumes only for five out of 31 ES have been directly evaluated to a relatively complete extent (Bukvareva et al., 2019a). The government statistics pay attention to only two components related to ES assessment: indicators of environmental pollution (indicators of demanded volume of some pollution-related ES) and a bioresource accounting system (indicators of supplied and consumed volumes of some productive ES). Un-

fortunately, the problem of lacking data has not been fully resolved in the last years. It was recently revisited in an article suggesting ensuring the availability and regular updating of data relevant to the assessment of ES that were already collected by Federal agencies (Bukvareva, 2019b).

Common gaps exist in the state, trends and spatial distribution of species. In Bulgaria, the assessment is restricted to areas outside the Natura 2000 sites, e.g. 67% of the national territory. Also the low availability of indicators for the impacts of some of the main pressures on biodiversity, such as pollution, climate change and invasive alien species has been recognised as well as the lack of sufficient information and research to assess functional relationships between ecosystem condition and ecosystem service supply, which leads to an equal weight of all indicators used in the assessment process (Bratanova et al., 2017). In Russia, the low reliability of data on bioresource use is a serious problem because of the large amount of unregulated, unreported and illegal bioresource harvesting (Bukvareva et al., 2019a). Most of the data needed for biodiversity monitoring are not available at national level, as they are present only in individual studies for individual regions, or none at all (Bukvareva et al., 2019b).

Data availability has been recognised as one of the main factors which restrict ES selection and a serious problem in the valuation process in Bulgaria (Koulov et al., 2017). The authors point out that data transfer from regional, national and even from global statistics is currently used, which greatly lowers the degree of valuation objectivity and hampers its validation. The provisioning ES dominate investigators' selection due to the relative availability of statistical data, which artificially increases their overall importance. The study of Koulov et al. (2017) also propose the assessment of key regulation ES to be estimated through indirect valuation methods, such as using scientific results as reference data. The authors also emphasis that regardless of the importance of ES as Pollination, Water Purification and Natural Hazard Protection, the lack of a reliable information base does not allow their adequate assessment. The choice of a representative valuation indicator for cultural services is severely limited due to the lack of an established practice in Bulgaria for data collection regarding this class of services, either at the local or national level. Another important uncertainty is recognised in the assessments of soil organic carbon storage which is due to errors in soil density and rock fraction estimates, lack of data on organic carbon variability and missing or poorly quantified data for below-ground biomass and environmental control parameters, as well as more detailed information for above-ground biomass in different vegetation cover types (Nedkov et al., 2017).

Markov, Nedkov (2016) reported about the limitation of the Universal Soil Loss Equation (USLE). They stated that each morphological unit was assumed to be homogenous and recognised as the main source of error for the C-factor values that were estimated from a satellite image. As an alternative method, which showed approximation values, they proposed the estimation of C-factor with NDVI analysis. They concluded that the assessment could be improved through the use of higher spatial resolution and through including recently acquired images from different periods.

Similarly, access to existing statistical databases containing information on the status, quantity and quality of services is an important issue in assessing ES in Russia. The commercialisation of data makes it challenging to acquire it. Earlier it has been noted that in the preparation of a national report on ES, the Government is obliged to guarantee free access to databases available in the relevant departments or to provide payment to commercial structures (Bobylev et al., 2013). However, this problem has not been resolved to date.

Updating data for protected areas is a separate problem in Russia. For example, there are significant difficulties with forest management on the lands with Federal protected areas – strict nature reserves (zapovedniks) and national parks. Huge areas of protected areas in Russia are covered by forests and require a regular forest survey. It should include carrying out forest inventory work to update information on the quantitative and qualitative characteristics of forests, as well as the creation of up-to-date databases adapted to modern geoinformation systems. However, according to the current Russian legislation, the recurrence periods for forest taxation are 15 years for national parks and 20 years for state (strict) nature reserves (Order of MNRE, 2018). During this time, the forest ecosystems of these territories are undergoing significant changes. Moreover, in some reserves, forest management has not been carried out since the dissolution of the USSR. This break is due to many factors, such as economic and political reforms in the country, the financial capacity of the process itself.

Administrative regions are used mostly as a spatial mapping unit for the national ES evaluation in Russia. It corresponds well to the state statistics (Bukvareva et al., 2019a). A similar approach has been implemented for some European sub-continental assessments (Maes et al., 2011; Schulp et al., 2014; Zulian et al., 2014). However, the constituents of the Russian Federation have unequal areas. A single value of an indicator could not adequately describe vast areas, such as Krasnoyarsk Krai, Yakutia and other large regions in Siberia, the North and the Far East of Russia because of the high diversity of natural and socio-economic conditions within these regions (Bukvareva et al., 2019a). Currently, there is no solution of this problem.

Water-related governmental agencies and scientific institutes operate according to river basins and not according to administrative units in Russia. Therefore, it is necessary to find the most effective algorithm for translating data on basins into administrative regions and management recommendations, and back from the grid of administrative units to basins (Bukvareva et al., 2019a). An additional problem in assessing water-related ES in most regions of Russia is the lack of hydrological information. First of all, this is relevant to mountain areas. The weather stations and other monitoring polygons in the mountains are sparse and placed in specific locations. Similar problems were noted for Bulgaria; there the lack of actual data was also recognised as the main disadvantage in the process of assessment of ES concerning data related to rivers discharge and real-formed surface runoff (Avetisyan et al., 2016). Studying the applications of GIS-based hydrological models in mountain areas in Bulgaria for ES assessment, Boyanova et al. (2016) reported for the problem with the low quality of the available input data, which decreased the model's performance. The application of

the hydrological model is possible. It opens new research options, but also realises the need of translation between the USA, European, global and Bulgarian land cover and soil classification systems, as well as the need for detailed weather data and a better network of weather stations.

The monetary valuation of ecosystem services is not very accurate. This problem has been already noted in both Russia and Bulgaria (Bobylev et al., 2013; Nikolov and Drenovski, 2017). Even though monetary valuation is the most simple methodically, it is extremely difficult to perform for some ES in both Russia and Bulgaria. Studies in Russia show that such an assessment suffers from imperfect methods that are powerless in the face of the complexity and intricacy of ecosystem functions (Zavadskaya et al., 2017). Bulgarian researchers also underlined that the prioritisation of certain ecosystem services, such as those for which there is a high demand or those that are particularly vulnerable to current pressures, could be a risk for important services or those that interact with important services via synergies or trade-offs and should be omitted (Bratanova et al., 2017). They conclude that the complex and dynamic geospatial interdependencies and interactions that exist among ecosystems often produce ES synergies – positive effects – which additionally increase the added value of the services they produce and cite as an example that the values of the Carbon Sequestration and Erosion Regulation services reduce the value of the Fodder ES (Koulov et al. (2017). In Russia, the situation is aggravated by the low sensitivity of market economy mechanisms to environmental problems. The traditional market ignores most environmental problems. Therefore, the economy is unable to correctly determine the benefits, damages and prices for ecosystem functions. Complex unresolved environmental and economic problems include the lack of prices for ES (for the majority of ES), underreporting of assessment concerning environmental damages, distribution and diffusion of benefits, inadequate reflection of the spatiotemporal factor due to the short- sightedness of the services market and underestimation of public goods (Bobylev et al., 2013). As noted for Bulgaria, but also valid for Russia, some services such as the cultural are more specific since their benefits are more qualitative than quantitative and their measures are highly subjective (Nedkov et al., 2014).

Furthermore, for certain services, supply potential can be differentiated from the actual supply. Such distinction would indicate the difference between the full quantity of a service that is present in the area (potential supply) and the quantity of that service actually used by the human society (actual supply). In Russia, for instance, the potential of recreational services for many regions is many times greater than their actual use. It is easier to differentiate those values for provisioning services than for regulating services and is extremely hard to separate the actually used regulating service climate regulation from the total supply of this specific service. The same is the case with flood regulation – the potential and actual supply overlap and represent the total capacity for the service provision.

Ambiguity in determining beneficiaries is another problem in the assessment of ES. For example, in Russia, recreational services (rest, health improvement, educational tourism, etc.) are critical at the local level as they are significant for the local

population, guests from neighbouring and even remote areas. These services are less important at the regional level since recreation is not a key link in the economy of most regions. However, in such regions as Karelia, Caucasus, Altai, Kamchatka, etc., the increasing flow of tourists contributes to development and economy (Bobylev, Zakharov, 2009). The Altai Mountains are a typical example of this situation. Such areas as Lake Teletskoye, Mount Belukha and the Ukok Plateau are known far beyond the borders of the region including areas outside Russia. Many tourists would like to visit these sites. Nevertheless, these areas are valuable both at a continental and global scale and are included in the List of UNESCO World Natural and Cultural Heritage Sites. The increase in the number of visitors can contribute to a significant replenishment of the regional budget. On the other hand, it can also lead to the loss of their essential characteristics. In this regard, there is no doubt that both the Russian state and international organisations should provide the region with compensation for restricting visitors.

The current problematic situation is far from being resolved. It is widely accepted that strictly protected areas have proven successful in most cases to protect ecosystems and biodiversity. They are strictly natural reserves and provide the highest carbon storage by preventing the conversion from forests to agriculture or tourism areas (Castro et al. 2015). Most of the ecosystem- services hotspots are included inside protected areas (Garcıa-Nieto et al., 2013), indicating that the conservation strategy provides ecosystem services. So a change in strategy could be argued against (Palomo et al., 2014).

In contrast, other studies have shown that substantial portions of hotspots of ecosystem services are located outside protected areas (Davids et al., 2016). In fact, stakeholders perceive that those protected areas that are embedded in multifunctional landscapes deliver more ecosystem services than do strictly conserved lands (such as IUCN protected-area categories I and II) or intensively managed lands (Martín-López et al. 2012). For example, Hannah et al. (2007) have pointed out the shortcomings of biodiversity conservation systems based on reserves alone.

In Russia, there is also an opinion that the strict protection regime typical for Russian zapovedniks makes it impossible to include potential services in the development of tourism. As already noted, for the integration of protected natural areas into the regional economy, it is important that they become not only symbols of society's humanitarian aspirations, but also contributors to the economic diversification (Tishkov et al., 2017). However, the same authors, referring to specific examples in another work, note that the massive influx of tourists to national and natural parks and their intensive recreational use conduce to landscape degradation. For instance, the recreational use of the lakes in the Valdaysky National Park leads to local degradation of forest and meadow vegetation of the coastal area, partial destruction of the protective (buffer) strip of aquatic vegetation, bank erosion in parking areas, pollution of shallow-waters by wastewater and debris, and decrease in the aesthetic value of coastal landscapes as a result (Belonovskaya et al., 2019).

Therefore, to our opinion one should agree with the view that protected areas downgrading, downsizing and degazettement (PADDD) presents a significant chal-

lenge to the prevailing conservation paradigm (Mascia, Pailler 2011). It has been repeatedly stated that the ecosystem services of Russia and especially its Siberian regions are valuable on a planetary scale. The world's largest areas of natural ecosystems preserved in the Asian part of Russia are of key importance for maintaining biodiversity in Northern Eurasia and for regulating the biosphere, including in particular climate regulation due to the large carbon reserves in peat, soils and permafrost (Bukvareva et al., 2015). The global functions of Siberian ecosystems will always be relevant and, over time, they will receive an adequate value expression due to the growing demand for a favourable environment. Given the enormous size of Russia and the presence of vast sparsely populated areas especially in its Asian part, it is challenging to find irrefutable arguments to justify the need to soften the regime of zapovedniks for the sake of short-term gain.

Conclusion

The development trends and challenges of the protected area systems in Russia and Bulgaria were very similar in the last decade of the twentieth century: rapid growth in the number of protected areas, the influence of international environmental organisations and the lack of governmental funding. Since the beginning of the twenty-first century, there have been differences related to institutional features within the countries. The turning point for Bulgaria was its accession to the European Union. The increasing role of the state in the management of natural resources has had a significant impact on nature conservation in Russia.

At the same time, there have been also common trends in recent years. Both in Bulgaria and in Russia, perceptions of the protected area functions have been changing, facilitated by global shifts. Thus, the concept of ES has now been actively introduced in nature and biodiversity conservation policies.

In Russia and Bulgaria, several common challenges have occurred associated with ecosystem services assessment. These challenges have been mainly related to the shortage and quality of baseline data. At the same time, there are also some specificity due to the size of the countries and legislation.

Like many other mountainous regions in the world, the Rhodopes in Bulgaria and the Altai Mountains in Russia are flagships in the improvement of nature conservation strategies. These regions often participate in a variety of international conservation programmes and are constantly expanding the range of protected areas. It is generally accepted that Altai and the Rhodopes are not only centres of biodiversity in their countries, but also hotspots of ecosystem services. The latter fact, however, has a negative side. The recent trend towards mitigation of the protection regime may have unpredictable consequences. And this question is far from resolved. We hope that the sustainability of protected areas will lead to science-based conclusions before society embarks on more proactive changes in line with the novel strategy.

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